Materials Science and Technology Division

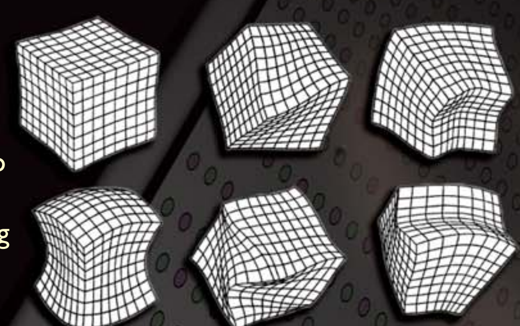
Physical Acoustics

Putting sound waves to work

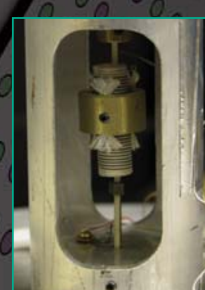
Sound waves can be harnessed for a surprising variety of important tasks. For example, researchers in the Materials Science and Technology Division use sound waves at frequencies and intensities far outside the range of human hearing to study how plutonium ages, to convert heat to power, to enrich isotopes, and to identify particles suspended in fluids.

Watching Plutonium Age in Real Time

Acoustics can be used to study the properties of solid materials. Measuring the resonance frequencies of small, solid samples that have an accurately known geometry gives the elastic properties of the solid with unprecedented accuracy and speed.



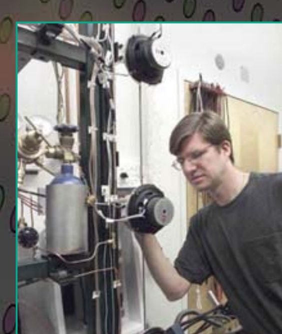
Studying Plutonium
How stable is the plutonium in aging nuclear weapons? To answer that question, Los Alamos scientists are watching plutonium age in real time. Shown here are exaggerated representations of cubes of plutonium, each resonating at a different frequency.



The Resonant Ultrasound Spectroscopy Cell
Measuring resonance frequencies is a technique especially well suited for working with tiny samples of rare or dangerous materials. Samples are placed between two buffer rods in a cell capable of reaching 600°C.

Thermoacoustics: The Power of Sound

Extremely intense sound waves sent through highly pressurized gases can convert high-temperature heat to acoustic power or electricity and can produce refrigeration or separate mixtures.



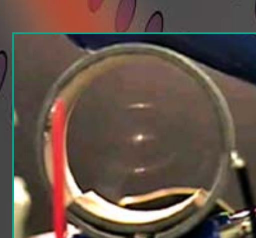
Separating Gas Mixtures with Sound
This simple arrangement of ordinary loudspeakers and tubing sends a pure (single-frequency) tone through a gas mixture in a closed tube, causing the different components of the mixture to accumulate in separate reservoirs. Here a mixture of two neon isotopes is being separated.

Thermoacoustic Refrigeration System
Powered by natural-gas combustion, this system liquefies natural gas at a rate of 350 gallons per day by cooling it to cryogenic temperatures all with sound waves.

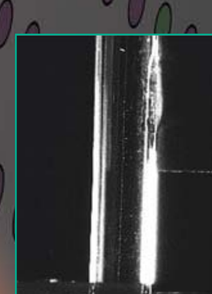
Liquefying Gas in the Field
We are designing a thermoacoustic natural-gas liquefier with a capacity of 20,000 gallons per day for use at small, remote wells. Pictured here is a small, offshore well serviced by two floating production platforms.

Concentrating Particles with Sound

To sort and identify particles, researchers concentrate them in liquids or air by using sound pressure and resonance. Acoustic concentrators are useful in a broad spectrum of applications, ranging from sorting biological cells in liquid to enhancing the sensitivity of instruments that detect airborne biological-warfare agents.



Sorting Biological Cells
Micrometer-sized particles suspended in water are concentrated at the acoustic node along the axis of a glass capillary tube. This approach can successfully sort biological cells.



Concentrating Particles in a Fluid
Micrometer-sized particles are concentrated by sound along three nodal lines in air in a piezoelectric tube. The lines are parallel to the axis of the tube.

Albert Migliori, MST-NHMFL, migliori@lanl.gov, 505 667 2515
Gregory W. Swift, MST-10, swift@lanl.gov, 505 665 0640
Gregory Kaduchak, MST-11, kaduchak@lanl.gov, 505 665 9471

Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is operated by the University of California for the United States Department of Energy under contract W-7405-ENG-36. LALP-04-025

The World's Greatest Science Protecting America

NNSA

Los Alamos NATIONAL LABORATORY — ESTABLISHED 1943 —